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*Framework for Identifying Autonomous Decision-Making Process in Energy and Environmental Issues: Case Studies in Indonesian Communities (*Rukun Warga*)*

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Abstract

Autonomous decision-making in this study is defined as the process whereby decision-makers autonomously find problems/goals and make decisions for achieving the selected problems/goals. It is performed in a responsible manner based on the information available. For renewable energy use or waste management, decentralized autonomous decision-making is considered to be effective, since local information related to energy demand and renewable energy use are indispensable for effective policy design. However, it is difficult to design policies for promoting effective autonomous decision-making, because there are various stakeholders who can independently make decisions regarding these issues, and they interact between each level within the hierarchical structure. This study aims to identify the autonomous decision-making process within a series of case studies, and is then analyzed to evaluate the contribution of each decision to achieving the goal. The local activities related to energy and/or environment in Rukun Warga (RW) communities are selected as case studies. Although a project/activity has been designed for the community, related decision-making is considered across every level of the hierarchy. A framework for autonomous properties identification is developed. Using four main steps in the framework, five communities in several Indonesian cities are investigated and described by using Petri-net. The framework developed in this study is utilized for identifying and extracting autonomous properties in practical decision-making processes.

Keywords: *autonomous; decision-making; community; Indonesia; hierarchy.*

Abbreviations:

RW	:	*Rukun Warga* (community organization)
RT	:	*Rukun Tetangga* (neighborhood association)
PKK	:	*Program Kesejahteraan Keluarga* (Women's Organization)
CBO	:	Community-based Organization
NGO	:	Non-governmental Organization

1. Introduction

Energy and environmental issues have attracted increasing attention over the years. With the increase in the price of energy and a growing global agenda towards realizing more sustainable development, many countries have been making decisions and policies to increase their energy efficiency and sustainability. Decision-making is a very dynamic process in which it is sometimes difficult to distinguish where and how the decision-making process starts and ends. The common definition of decision-making is a process of identifying and choosing alternatives in order to achieve a certain goal. With many stakeholders involved in this particular area of interest, it creates complexity in the decision-making context and processes in the energy and environmental field. The key stakeholders who usually participate in environmental decision-making are governments, regional governmental organizations, business associations, environmental advocacy groups, community/neighborhood groups, and affected or interested individuals [1]. These stakeholders typically have either a parallel or a hierarchical relationship with each other.

Each stakeholder, whether individual or collective, is seen as an autonomous system [2], meaning that each has the autonomy to make decisions, select goals, and take actions. Autonomy is frequently defined as independence. From the political and public administration point of view, autonomous is translated as delegation of power or independence from central power [3], [4]. In this paper, we argue that being autonomous is different from being independent. The term 'accountable autonomy' in [4], clarifies our argument. The study on autonomy in public schools and neighborhood safety argued that autonomy means independence, but also requires accountability from and to every stakeholder. This term is somewhat paradoxical, but the study showed that external support and guidance is needed to realize autonomy [4] and therefore, collaboration and cooperation are undertaken if necessary.

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Based on this, our study rejects the notion that autonomy is purely about independence of the stakeholders to do anything in isolation and abdicate responsibility. Autonomy is the ability that results from self-motivation, self-determination, and self-control characteristics. These characteristics bring the ability to take charge, find goals, self-govern, self-learn, take responsibility for actions taken, and initiate collaboration and cooperation if necessary.

The definitions of decision-making and autonomy have guided us into developing a definition of autonomous decision-making as "the process in which decision-makers have the freedom and ability to find problems, select goals and make decisions for achieving the selected problems/goals in a responsible manner based on available information". In real situations, each of the decision-makers does not fully understand how to reach the goal due to uncertainties in the situation and interaction of stakeholders. Among the type of stakeholders and their relationships listed in [1], we focus here on a hierarchical structure of decision-makers. We argue that autonomous decision-making is made in every hierarchical structure of decision-makers, ranging from the national government, local government, to the community and individual levels. The interaction and role allocation within the hierarchical structure need to be understood in order to evaluate the contribution of each of the decision-makers to achieving the goal.

In the hierarchical structure of decision-makers, community is positioned between the government institutions and the individual level. The involvement of the community in policy-making is often promoted in order to achieve a better decision and implement it successfully. Decisions made by individuals are subject to social influences, which affect the decision-makers to behave in anticipation of how they will be evaluated by others even when they operate alone [5]. Community engagement in making decisions can thereby act as a conflict resolution method and still produce good outcomes [6], because it will make the decision-makers think and decide more carefully in front of other stakeholders.

In the field of public policy and governance, involvement of community in public decision-making is strongly recommended by various scholars [7]–[10]. They favored local autonomy because they fear that the centralized government tends to force their power over local prerogatives and ignore local wisdom [4]. Meanwhile, other scholars criticized the concept of delegating too much autonomy to locals, because it may create community segregation and instability, favor the haves over the haves-not, and cause ineffective and costly decision-making [11]–[13]. Community involvement in decision-making is also studied in the field of natural resources and environmental decision-making [14], [15] and energy planning and development [16]–[18]. These studies showed that the community level is an interesting object of study, especially related to decision-making in the energy-environmental field. However, most of these studies emphasized only the community level as the boundary of the system, both the activity/behavior system and the decision-making system. This study differentiates the boundary of the activity/behavior system and the decision-making system. The boundary of the activity or behavior system is set at the community level, whereas the decisions of all of the hierarchy levels may be included in the decision-making system.

In the Indonesian context, a community institution known as *Rukun Warga* (RW) is a good example for studying autonomy in decision-making. Community institutions, including RW, are organizational units which stand outside the formal administrative government structure and have the right to self-govern and a mechanism to make decisions regarding community development [19]. The activities performed within the RW community exhibit collectivity, but the scale is small enough to be investigated thoroughly in a limited time. The RW community plays a role as a bridge that connects individuals and upper authorities' decision-making, which is one of the reasons why this particular level is investigated here. By looking at RW communities, the decisions made by upper and individual levels can still be covered and their role in the decision-making process are recognized.

The work presented in this paper aims to show how to identify autonomous decision-making processes by analyzing selected cases in several communities from the point of view of autonomy. The communities investigated are those who have conducted energy or environmental projects or activities. The framework for autonomous property identification (Figure 2) is designed to fulfill this purpose. The Petri-net method is utilized for analyzing the case studies. Petri-net is event-driven and able to represent parallel decisions [20], therefore it is suitable for decision-making analysis. This method is used for analyzing various decision-making processes. In relation to energy issues, Petri-net has previously been utilized to analyze a more energy efficient decision-support system in manufacturing [21]. Meanwhile in the environmental field, Petri-net has been used as a decision support system in choosing sustainability indicators for regional development [22], in managing municipal waste [23], and in modeling environmental effects of biofuels utilization [24]. Despite the wide range of foci of these studies, they exhibit similarity by employing Petri-net for modeling a system to help making energy and environmentally-sound decision. In this study, the decision-making system is made by decomposing the existing decision-making process in the cases according to the framework, and representing it by using Petri-net. Other studies that exhibit more similarities in utilizing Petri-net are found in a study which models a legal case [25] and studies that model a story plot for games [26], [27].

The hierarchy of decision-making in an Indonesian context, and the history of RW, is briefly explained in the next section. The third section explains the methods used to identify autonomous properties. The autonomous decision-making properties are identified through case study analyses. The cases presented in this paper primarily focus

on energy and environmental issues; however, some other issues, such as social issues, are also briefly included. The analysis of each case, in the form of descriptive explanations and Petri-net graphs, is presented in the fourth section. A discussion regarding the autonomous properties extracted from the cases is presented in the fifth section, followed by concluding remarks.

2. Overview of the *Rukun Warga* Community in an Indonesian context

This paper investigates the autonomous decision-making process from cases at the RW level, which is translated into English as the 'community' level. RW is a unique unit of organization that exists in Indonesia. This civil organization did not exist during the Dutch occupation, which only formed the village (*desa*) level as the lowest administrative structure. Historically, the Japanese military government in Indonesia developed the origin of the RW community during World War II. To rule and keep a close watch on the civilians, they formed *Tonarigumi*, an association consisting of 10-20 households lead by a *Kumicho*. Several *Tonarigumis* formed an *Aza*, which was led by an *Asacho*. One village consists of several *Azas*. After gaining independence, the Indonesian government turned the *Aza* into the RW community, and *Tonarigumi* was turned into the Neighborhood/Rukun Tetangga (RT) [28].

Although the hierarchy is similar to that formed by the Japanese, the function and characteristics of the RW in Indonesia are different from similar civil organization in Japan[1]. RW is an informal organization with a non-administrative structure found in most cities and regions in Indonesia. RW is also a civil organization approved and nurtured by the government to preserve the local values of the Indonesian people, especially mutual assistance (*gotong-royong*) and kinship (*kekeluargaan*) and to assist and accommodate the duties of the village (or sub-district, if it is in urban area) [29]. The number of RTs in each RW and the number of households in each RT vary, and some cities and regencies even stipulate the minimum and maximum numbers in their laws. In Bandung City, for example, one RT consists of thirty to seventy-five households; meanwhile, one RW consists of five to fifteen RTs [19].

Above the RW rank, formal authorities start from the national government to the provincial, city/regency, district, and sub-district authorities. In contrast to the village or sub-district, both RW and RT are indicated only by numbers and not by names. The RW is the highest informal authority of decision-makers in Indonesia (Figure 1). RW is considered as an informal institution because the Chief is elected by the people and is not appointed or paid by the government. The Chief is often elected through consensus instead of voting, and often, the RW Chief is trusted to occupy the position for years or multiple terms. The RW and RT membership and work are voluntary. Because they fall outside of the formal administrative structure, the RW and RT are not subordinate to the sub-district/village office. However, any members who need sub-district/village service often require a letter of recognition or cover letter from the RW/RT Chief as proof of their citizenship.

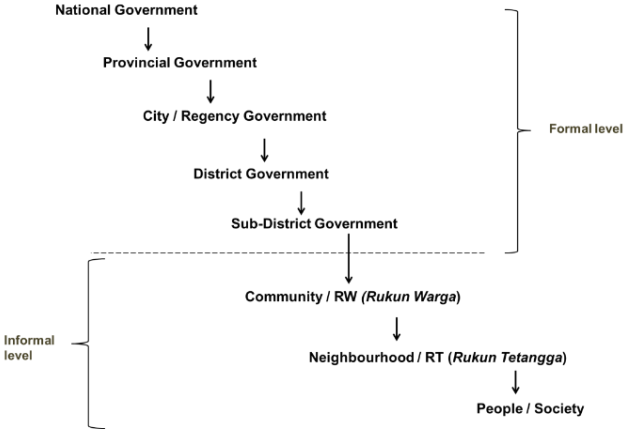

Figure 1 Hierarchical structure of decision-making in Indonesian society

Indonesian people, in line with their culture and customs, view their neighbors as the closest family they have. Therefore, establishing a close relationship with their neighbors is very important and often creates strong bonds between the RW and RT members. Whenever personal activities such as weddings, funerals, or house renovations occur, the community members are automatically invited to help each other without prior notice. This is the primary reason that the RW structure often plays an important role in the success of government programs, such as LPG conversion, poverty alleviation programs, housing relocation programs, infrastructure improvement, etc. The RW Chief, elected through consensus, is often a renowned person and trusted by the community. Therefore, information dissemination and community mobilization are more easily undertaken regarding the support of government projects if they are undertaken through the RW. The relationship and participation level of community members are different. In urban areas, the relationship between RW members may be weaker due to busy work schedules and a multicultural background [30]. Currently, however, RW which have strong bonds among their members and strong leadership can easily be found in urban areas or big cities.

RW and RT organizations may not exist in some Indonesian cities or regions, but other similar organizations, such as *Dusun, Dukuh, Kampung, Blok, Lingkungan*, etc., exist depending on the local situation and customs. These organizations perform similar tasks and activities to the RW

[1] In Japan, the community organization similar to RW is called *chōnai-kai* (町内会).

and RT. In addition, RW and RT do not only function as community institutions, but in daily life they also function as an address. In this paper, the discussions and cases presented are limited only to areas where RW and RT exist and are located in big cities such as Jakarta, Surabaya, and Bandung.

3. Research Methods

In this paper, the decision-making process in each community is investigated and broken down based on the decision-making process and history. The autonomous portion of the decision-making process is extracted, then each case's decision-making process is evaluated from the autonomous viewpoint.

3.1. Data collection

Five communities, which present clear activities in energy and environmental issues in urban areas, were chosen to be investigated in this paper. These five communities show different degrees of autonomy in decision-making, which is substantial for the autonomous property identification purpose. The information used in this investigation was obtained through face-to-face interviews, direct observations, and from secondary information. The face-to-face interviews were conducted in twenty communities located within Bandung City only. Two of the cases were selected because of the depth of information and because they exhibit unique processes. The other three cases are located in different cities. They were selected because we considered them as best practices, but they were not visited due to limited resources. Information was obtained based on secondary information from research reports, journal papers, and news articles. The depth of information obtained was necessarily different between the two types of cases, but we attempted to select cases with sufficient information to enable detailed analysis. The cases analyzed in this paper and the sources of information are listed in Table 1.

In cases in which interviews were not conducted, secondary information played an important role. Because the communities were not visited, cases with detailed information and sources were more likely to be chosen for this paper. The substantial information needing to be collected in order to draw the decision-making diagrams include, but are not limited to, the following: (1) who initiated the program, why, and how; (2) how the community responded to the idea/proposal from proponent; (3) how the community obtained information and knowledge about the program; (4) how the community made decisions in response to the proposed program; (5) how the community usually made decisions regarding daily community problems and incidental programs; (6) how the community found financial support for implementing the program; (7) what type of routine activities were employed in the community before and after the program happened. This is the minimum information to be obtained either through interviews or secondary sources in order to draw the Petri-net diagrams of the decision-making process and understand which components are performed autonomously.

Table 1 List of the case studies and their information sources

Case	Data collection method	Source of information
Biogas project in a cow farming community in Lembang	Secondary data	Primarily from the BIRU official website, www.biru.or.id
Community-based waste management in Surabaya	Secondary data	Research reports and project publications, primarily retrieved from http://kitakyushu.iges.or.jp
Biogas project from household waste in Bandung	Primary and secondary data	Interviews with the RW Chief, former Chief, and the person in charge of the biogas site; project reports
Green community project in Jakarta	Secondary data	Theses, reports, and newspaper articles
Community beautification and maintenance in Babakan Asih, Bandung	Primary and secondary data	Interview with the Chief of RW 01, project reports, and newspaper articles

3.2. Data analysis

The decision-making process diagram for each community is described and drawn based on the framework in Figure 2. This framework was developed by modifying the decision-making process phases presented by Herbert Simon, who introduced three phases of the decision-making process: Intelligence, Design, and Choice [31], [32]. We developed our framework from the viewpoint of autonomy at the community level, which heavily relies on consensus building in the decision-making process. This differentiates our framework from the original concept developed by Simon.

The story of each case is described chronologically based on the data, then it is explained according to the framework. Afterwards, diagrams of the decision-making process are drawn using the Petri Networks (Petri-net) method. Petri-net is usually used to describe and analyze processes, flows of information, communications and controls in systems, particularly where there are concurrent and asynchronous events [33]. This method was developed by Carl Adam Petri in 1962.

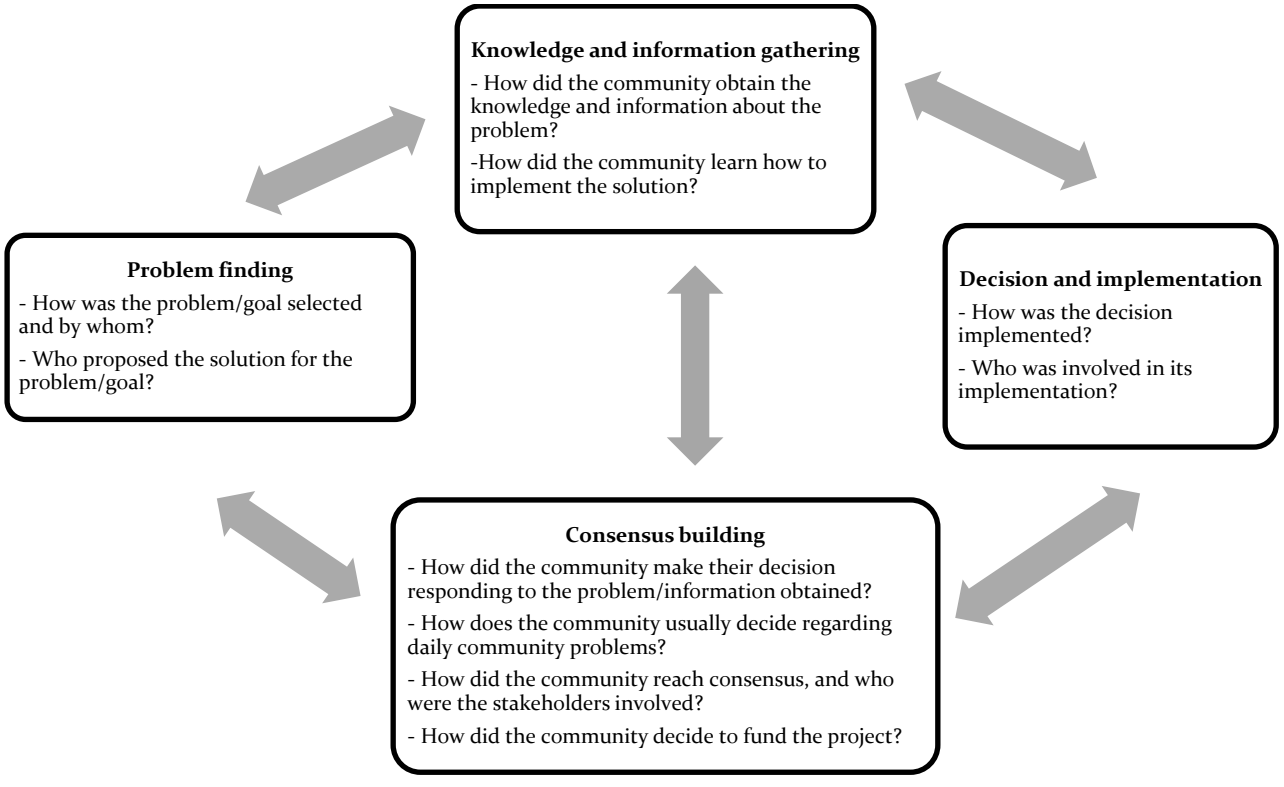

Figure 2 Framework for autonomous property identification and necessary key information

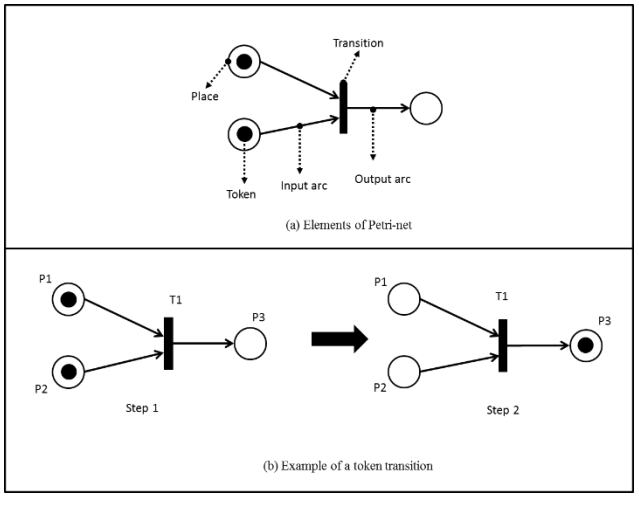

Figure 3 Simple Petri-net model

A standard Petri-net consists of P, T, I, O, μ (places, transitions, input, output, marking/token) [34] here: Places, represented by circles; Transitions, represented by rectangles/bars; Inputs, represented by arcs from P to T; Outputs, represented by arcs from T to P; and markings (μ), represented by a small dot called a token. An example of a simple Petri-net is provided in Figure 3. The Petri-net method is utilized to explain and investigate the autonomous decision-making in this research because it can simulate many activities sequentially and in parallel, therefore it is suitable for multi-stakeholder process representation. There are several main steps for translating the story of the cases into the Petri-net diagram:

1. A standard Petri-net for a decision-making process usually starts with actor(s), drawn as a Place (P).
2. The decision-making process conducted by the actor(s) is explained by Transitions.
3. The movement of token (μ) from Places (P) corresponds to the result of the decision-making, and events caused or occurring during decision-making.

All the possible outcomes of the decision-making are included as Places (P), including the least favorable options: project failure, stagnancy, termination, etc. The utilization of Petri-net to draw the community decision-making process caused the autonomous part of the decision-making to become more prominent and easier to be identified.

4. Results

Cases presented in this section are sorted by the approach utilized in the decision-making process. The first two cases exhibit a more top-down approach than the two latter cases. One case that exhibits a combination between top-down

and bottom-up approaches is also presented here. Because the focus of the diagrams is on the autonomous decision-making components, some detailed historical information is not described in the diagrams. Moreover, the processes that occurred in the community are described in more detail than the decisions made at higher levels of authority, such as at the national or city government levels.

4.1. Case 1: Biogas project in a cow farming community in Lembang, Bandung Regency.

BIRU (*BIogas RUmah*, meaning Home Biogas) was financed through a Dutch government grant. It was a nation-wide pilot project performed in a rural area from 2009 to 2013 and was particularly targeted at cow farming communities. These biogas pilot projects were started in eight provinces in Indonesia, and one of the villages selected for this project is the *Cibodas* Village in the *Lembang* District of the West Java Province, in which the majorities were cow farmers.

Because the project was a nation-wide collaboration between the national government and an international NGO, the problem was obviously defined by higher authorities. A BIRU organizer selected the pilot project locations. The community was then consulted after the project was ready to be implemented. Capacity building within the communities was conducted through a series of formal socializations and training sessions, and the implementation relied heavily on the co-op's role in giving soft loans to the cow farmers. The co-op was developed at approximately the same time as the approach and negotiations with the city government; therefore, during communication with the cow farming community, the co-op was already established and ready to operate. This co-op was a different institution than the existing co-op established by the cow farmers.

The autonomous component of the community decision-making process primarily occurred at the stakeholder gatherings. Although national authorities had already agreed on the project, many small and technical issues had to be resolved at the community level. The financial issue was the biggest concern. The construction of biogas reactors was very costly for the cow farmers, and building the biogas reactors was almost impossible to afford without any financial help. The financing loan scheme was discussed quite intensively in the meetings. This was expected by the project organizer; therefore, in the original plan they outlined the development of a functioning co-op to aid in financial matters. Another decision reached in the stakeholder meetings was to facilitate the funding and use of one reactor by two or more farmers. Although the project was a success, the decision-making process in this case is classified as a top-down process, and the autonomy of the community was almost nonexistent. The decision-making process for this biogas project is presented in Appendix 1.

4.2. Case 2: Green and Clean Campaign in Surabaya City

This campaign was collaboration between the Surabaya City Government with the Kitakyushu City Government under the name of the Kitakyushu Initiative Network (KIN). Surabaya was involved as one of the initial targeted cities of KIN before the project was replicated in other cities in Southeast Asian countries. The pilot project in Surabaya started in 2004 as a city-to-city environmental program aiming to reduce the amount of waste disposed at the final disposal site.

A local NGO named *Pusdakota* was formed to implement this project in the RW community. The *Pusdakota* composting center was opened in one community as a pilot project. *Pusdakota* also started functioning as a community waste station by collecting and separating organic and inorganic waste, including recyclables, thus encouraging waste segregation at one source [35]. After six months of trials and errors, the *Pusdakota* composting center was considered a success and was then replicated in other RWs in Surabaya.

The scaling-up procedure was performed by Surabaya City by purchasing composting baskets from *Pusdakota* and distributing them to the RW Women's Organization (PKK) members in several selected RWs. Training was also provided to the leaders of PKK, and they were recruited as 'environmental cadres', who then dispersed and taught the composting activities to housewives in their RW. The environmental cadres also monitored the housewives, which is probably why the composting practices were sustained among the households. Another interesting approach taken by Surabaya City involved using the media to cover the program and initiating a city-wide campaign named the Green and Clean Campaign with award provisions for the cleanest RWs. The wide coverage by the media caused other RWs to become interested in replicating the program even if they were not selected as pilot projects in the first place.

Regarding autonomous decision-making, the initiatives and innovation were obviously made by Surabaya City, especially the Cleansing and Landscaping Agency. The role of the PKK and their environmental cadres were very important in making the project successful. In summary, the problem was defined by the collaboration between the city government and an international NGO. The location of the pilot projects were selected through several meetings with District officials. The RW community was consulted after the project was ready to be implemented. Capacity building within the community was conducted through a series of formal socializations and training sessions. The degree of community autonomy after city-wide coverage and after the project had finished is unknown. Despite the project being successful, the decision-making process in this case is heavily classified as a top-down process. The decision-making process for this project is presented in Appendix 2.

4.3. Case 3: Biogas from household waste in RW 11, *Cibangkong* Sub-District, Bandung City.

The biogas installation project was an improvement to an existing composting project in the RW 11[2] community, which was one of the low-income, slum areas in Bandung. The community is inhabited by 3,000 people, or 800 households, making this area one of the densest districts in the city. Recognizing the need for the improvement of community life, a project named Community-based Basic Infrastructure Improvement Program was initiated by the Ministry of Public Works in the Bandung Branch with assistance from the Bandung City government in 1996. Focusing on economic, social, and environmental aspects, one of the projects conducted was the construction of a composting center located in RW 11 to improve the poor sanitation and waste situation. Later, the composting project became stagnant, and was replaced by a bio-methane installation.

The second project (the bio-methane digester project) was relatively more autonomous. After the composting system was not as successful as planned, especially in terms of profit, it was terminated between 2009 and 2010. However, views on waste and garbage in the RW 11 community had changed. They kept the waste segregation activities, and the women`s organization began selling plastic waste and tried to reuse it for handicrafts. Moreover, the existing CBO tried to seek financial support by submitting proposals to international and national organizations/NGO. Eventually, with assistance and consultation from academic scholars, the Environmental Agency, and a local NGO, and financial help from the local bank, the composting system was changed to a bio-methane system, which produces biogas for households and liquid fertilizer. The decision-making process for this project is presented in Appendix 3.

4.4. Case 4: Green community project in *Cilandak* Sub-district, Jakarta.

The first decision made to green the community environment was initiated by a housewife named Mrs. Harini Bambang in 1986. She was an active member of PKK in RW 08 of *Cilandak* Sub-district, Jakarta, and promoted her idea continuously to the other PKK members. A number of members agreed, and they started to plant some greenery and flowers around their houses. She often invited other housewives to her house and informally raised their awareness towards a green and clean environment. When Mr. Bambang, her husband, became the Chief of RW 08, he supported the practice by introducing the idea to community gatherings and proposed that the activities be performed by all community members. These gatherings decided that the PKK project that Mrs. Bambang started should be copied by all members; therefore, a specific organization called the 'Dahlia' Farming Group (*Kelompok Tani Dahlia*) was developed in 1992 to organize such activities. One of the drivers of this decision was the dry and barren environment in RW 08 of *Cilandak* District.

The success of this activity pioneered by the 'Dahlia' Farming Group of RW 08 attracted attention from the local government and private sector. Based on the work in [36], the community then gained a great deal of support in many forms, such as environmental-awareness training and women`s empowerment training from the local government, a Corporate Social Responsibility fund from a third party, and technical consultation and training from local and international NGOs. From these types of capacity building, the initiatives then continued into and improved other environment-related activities, such as waste segregation and composting, recycling and making souvenirs from waste, planting medicinal plants and making herbal medicine, etc.

In this case, the problem was recognized by the initiative of an individual, Mrs. Harini Bambang, who was motivated by her childhood experience and memories of living in the village. The autonomous decision-making components in this case occur primarily on two occasions. The first case of autonomous decision-making included the decisions made among the members of the PKK organization. This decision was not executed instantly, and Mrs. Bambang needed years to influence the other members to agree and copy her practice.

Finally, increasingly more housewives copied her activities, and the accumulation of these practices created a better environment. The next decision-making process occurred at the community level through community gatherings. This, too, was acted upon iteratively until a decision was made. Knowledge and information gathering phases were unplanned because the local government and third parties who were attracted to this community's efforts offered them training and capacity building workshops. The decision-making process for this project is presented in Appendix 4.

4.5. Case 5: Community beautification and maintenance in Babakan Asih, Bandung City.

The history of the Babakan Asih community in improving the community environment was first initiated by a youth living in that area named Mr. Reggi Kayong Munggaran. At first, he wanted to improve the social problems faced by the unemployed youth in that area, especially problems involving drugs and violence. He persuaded two parties to become involved. First, he persuaded the community officials, and second, he appealed to the troubled youth. These strategies succeeded, and the social problems started to fade away. The urban problems later came into focus as a

[2] RWs are only identified by numbers. RW 11 means it is the 11th Rukun Warga in existence in that particular sub-district/village. Similar identification is also used for numbering the RTs.

solution for the unemployed youth who needed a job. The community trusted them to construct several community infrastructure components, such as absorption well, a community hall, community parks, etc. Aside from improving their quality of life, the environment was also improved. The community began to become an empowered community. Many good ideas then emerged from the community and were subsequently well executed. A number of follow-up actions such as establishing community co-ops for financing small-scale entrepreneurship and waste management collection were results of the community gatherings. The decision-making process for this project is presented in Fig. 6 based on information provided by Mr. Dahyati, the Chief of RW 01, through an interview. Other sources of information include secondary records, such as newspaper articles and project presentations/proposals.

In this case, the problem was recognized by Mr. Reggi. He expressed his concerns to the RW Chief. The autonomous component in this decision-making process occurred several times. Firstly, the decisions were made only between Mr. Reggi and the RW 01 Chief and his ranks. The decision at that time targeted the jobless youth and provided them with positive activities and jobs. Therefore, the limited and informal discussion resulted in a decision targeting a limited population of persons. The decision implementation was a success, and more community members were attracted to the activities, started to provide ideas and opinions, and showed their enthusiasm for tackling wider community problems. Therefore, larger gatherings were held that invited all community members to reach a consensus. Other stakeholders, such as experts, academic scholars, local NGOs, and higher government officials, were sometimes invited to the meetings, if necessary. The community gatherings became an important outlet for the community members to communicate and make decisions, although several specific organizations were responsible for particular activities[3]. The decision-making process that occurred in the RW 01 community is described in Appendix 5.

5. Discussion

We have developed a framework (see Figure 2) in order to identify autonomous properties in the five cases of practical decision-making. We investigated and analyzed the decision-making process from each case based on the framework. In order to show more detail of where and at which stage the autonomous properties play a role in each case, each decision-making process is presented using Petri-net. The processes where autonomous decision-making occurred are shown in the Petri-net diagrams (green colour). After each case was analyzed using the same four factors in the framework, the Petri-net diagrams further show the differences occurring in each decision-making process.

In general, the 'consensus building' factor plays an important role in Case 1, and Case 2. This is because the project was defined and planned by the government and in order to be implemented they needed the community to agree with them. Even though the process of reaching consensus might be altered by the governmental pressure, this component is still very important in the success of the project. Meanwhile for Case 4 and Case 5 that exhibit a more bottom-up approach, the 'problem finding' and 'decision and implementation' are considered as important factors for the project to succeed and be sustained. In these cases, the two factors were very much linked because practically, the implementation part was more a trial and error process, therefore the community was actually defining the problem multiple times (every time they met an error in implementation).

Case 3 is a little bit special, because it actually consists of two projects that occurred consecutively. The initial project was mainly initiated by the government, therefore the 'consensus building' part played an important role. However, in the latter stage, the 'information and knowledge gathering' also played an important role, especially when the community tried to establish their own bio-methane digester project with the help of other stakeholders. In detail, the five cases are discussed below, based on the four factors identified earlier.

(1) Problem finding.

The methodology of drawing the decision-making process depends on the history of the case, and all of the cases began as a result of problem recognition. In Case 1, Case 2, and Case 3, the problems as well as the solutions and the site location were defined by higher authorities. In these three cases, the communities were involved as the executors. These cases tend to exhibit a more top-down decision-making process. This is indicated by the existence of 'document/plan/policy' box, which point out the decisions made by higher authorities. In Case 4 and Case 5, in which the initiator emerged within the community, the decision-making process was first started by the initiator and community leaders. They needed a longer period to convince other community members, but eventually, the other community members were willing to become involved in the activities.

(2) Knowledge and information gathering.

The next stage is how the community gained knowledge and information regarding problem solving. In the first three cases, the community was trained and informed through planned training and dissemination. This training increased their awareness of energy and environmental issues and increased networking among

[3] Currently, several formal and informal CBOs exist RW 01 community, such as a co-op, a cartoonist organization, etc. However, the RW 01 community gathering is still the main media for deciding the community actions and activities.

the community members and between the community and other stakeholders. In Case 4 and Case 5, the success of the community projects was highly dependent on the participation of the community members. The projects did not initially receive the attention and support of the local government. The initiator, along with several community leaders, attempted to obtain more knowledge and information through self-education, networking, informal consultations, etc. Formal training was conducted after the activities were successful and were acknowledged by other parties.

(3) Consensus building.

How the community made decisions and reached consensus through formal and informal gatherings, shows the degree of autonomy of the community. In Indonesia, consensus is the way that almost every RW community makes decisions. The decisions are made through RW community gatherings, attended by almost all community members. The leadership strength, local culture, openness to other stakeholders and to new information, intervention from government or other parties, are among the factors that can influence the decisions made by an RW community gathering. Therefore, the degree of autonomy can be seen by how the community decisions are made. Actions taken after the completion of the project also mirrored the community's degree of autonomy. A community with stronger autonomy will be more likely to continue improving the project or solve other problems by making autonomous decisions (Case 3). Meanwhile, those with a lesser degree of autonomy will most likely become stagnant (Case 1). In Case 4 and Case 5, the consensus was reached through at least two types of consensus. The first consensus was among a smaller and more limited set of community members, who were approached by the project initiators. Through these limited and informal meetings, the community activities were then implemented by a limited set of people. These limited activities were successful, and they then became recognized and accepted by other community members. They then tried to learn and replicate the practice or were willing to participate actively in the community activities.

(4) Decision and Implementation

In terms of implementing the decisions, we found similarity in all five cases, where a community-based organization (CBO) was formed. CBO is an organization within the community, but outside the 'standard' organizations that commonly existed in an RW such as the Women's Organization and Youth Organization (*Karang Taruna*). These CBOs usually function as the daily operational base of the project, including searching for experts' opinions and assistance, and looking for governmental support or third-party sponsors. In Case 1, Case 2, and Case 3, the formulation of a CBO was something that was already outlined according to the plan from higher authorities. In Case 4 and Case 5, the initiator and high-ranking community members became actively involved and formed the CBO, which then functioned as the wheel that further improved the community activities. In addition to the CBO, in Case 1 and Case 5, community co-ops were also formed to help the community members' finance the project. The establishment of CBO for a specific purpose, was seen as a good indicator for decision implementation. In addition, the existence of CBO to some extent can help the community to direct and achieve their goals.

In terms of autonomy, the community or stakeholder gatherings have a great potential to make decisions autonomously. However, in cases in which the problems were recognized by higher governmental institutions, the community gathering did not strongly exhibit autonomous decisions or actions. The possible reason is because the project had already been planned and outlined first by the institutions that recognized the problems. The community gatherings in all cases are considered to have some degree of autonomy because of the detailed decision-making process occurring in the gatherings. Overall, autonomy in decision-making is more prominent in the last three cases, where the initiative to conduct the project comes from the community itself. This corresponds with the amount of green color in each graph. In cases where autonomous decision-making is more prominent, there is more green shown in the decision-making process graph.

6. Concluding remarks

In this paper, the procedures for extracting the autonomous properties in decision-making were shown for Indonesian communities. Five communities were selected, and each case was analyzed and described by a Petri-net diagram. After analyzing the cases, all of the community activities appeared to have some degree of autonomous decision-making within the process. To summarize, at least four important key factors need to be follow in order to identify the autonomous properties in the decision-making processes: (1) Problem finding, how was the problem/goal selected and by whom, who proposed the solution for the problem/goal; (2) Knowledge and information gathering, how the community obtained information about the problem and learn how to implement the solution; (3) Consensus building, how the decisions are reached, and (4) Decision and implementation, how and who implement the decision and put it into action. The result of this paper is the first step in developing an autonomous decision-making model for policy-making. Future work will be related with determining under what conditions do the autonomous decision-making is required or more desirable for succeeding a decision.

Moreover, such social processes showing the success of environmental activities at the local scale are seen as important components that can inform sustainability

activities elsewhere. In the spirit of "thinking globally, acting locally" autonomy in decision-making is an important component in recognizing local problems and producing local-solutions that can be models for broader community action.

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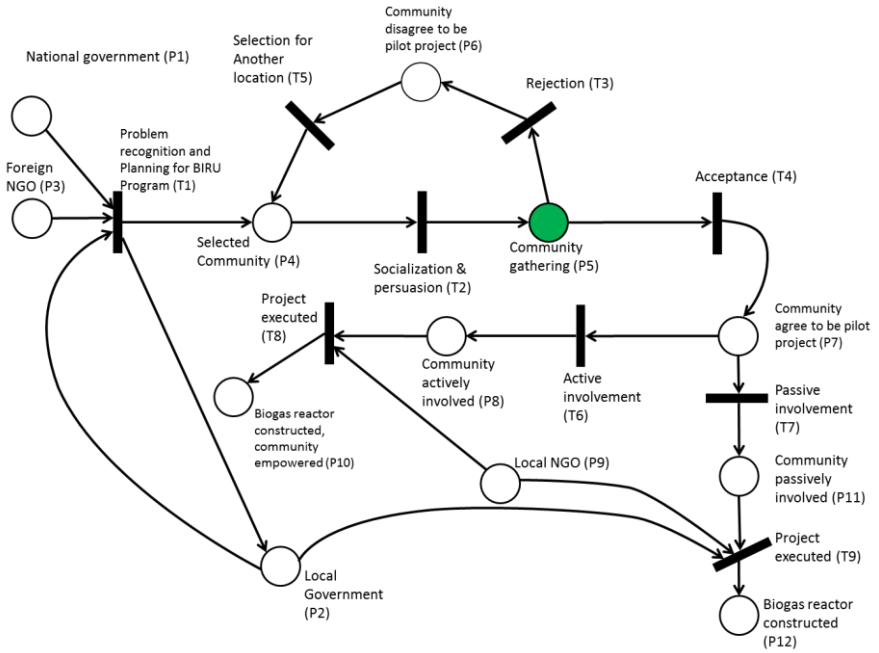
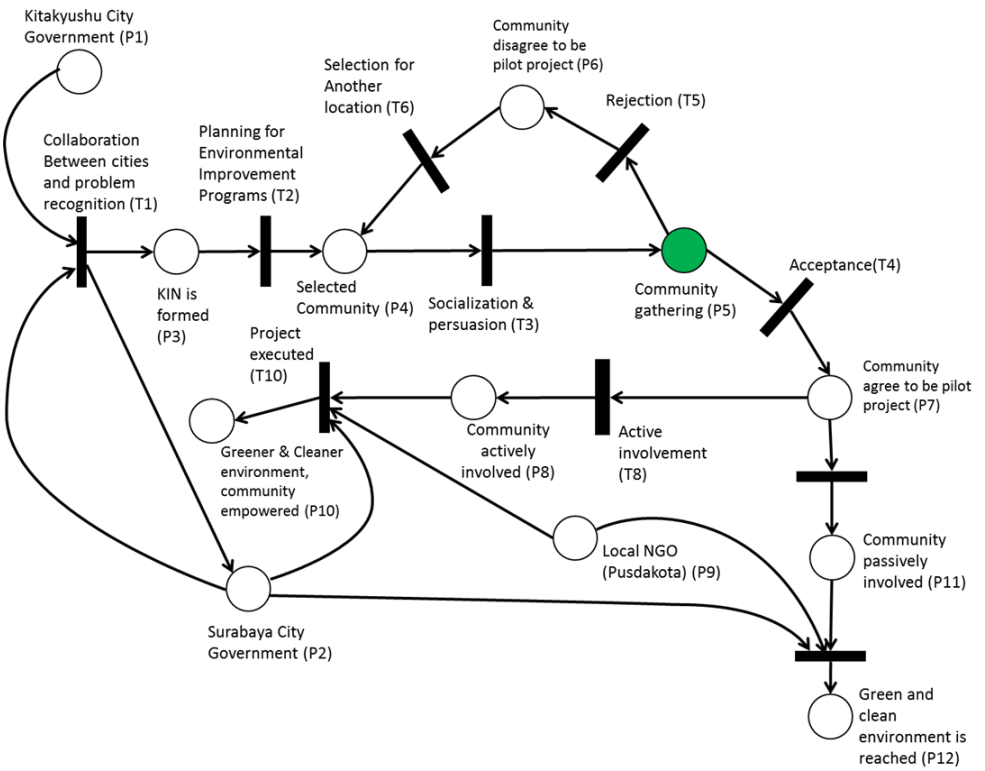
Appendices

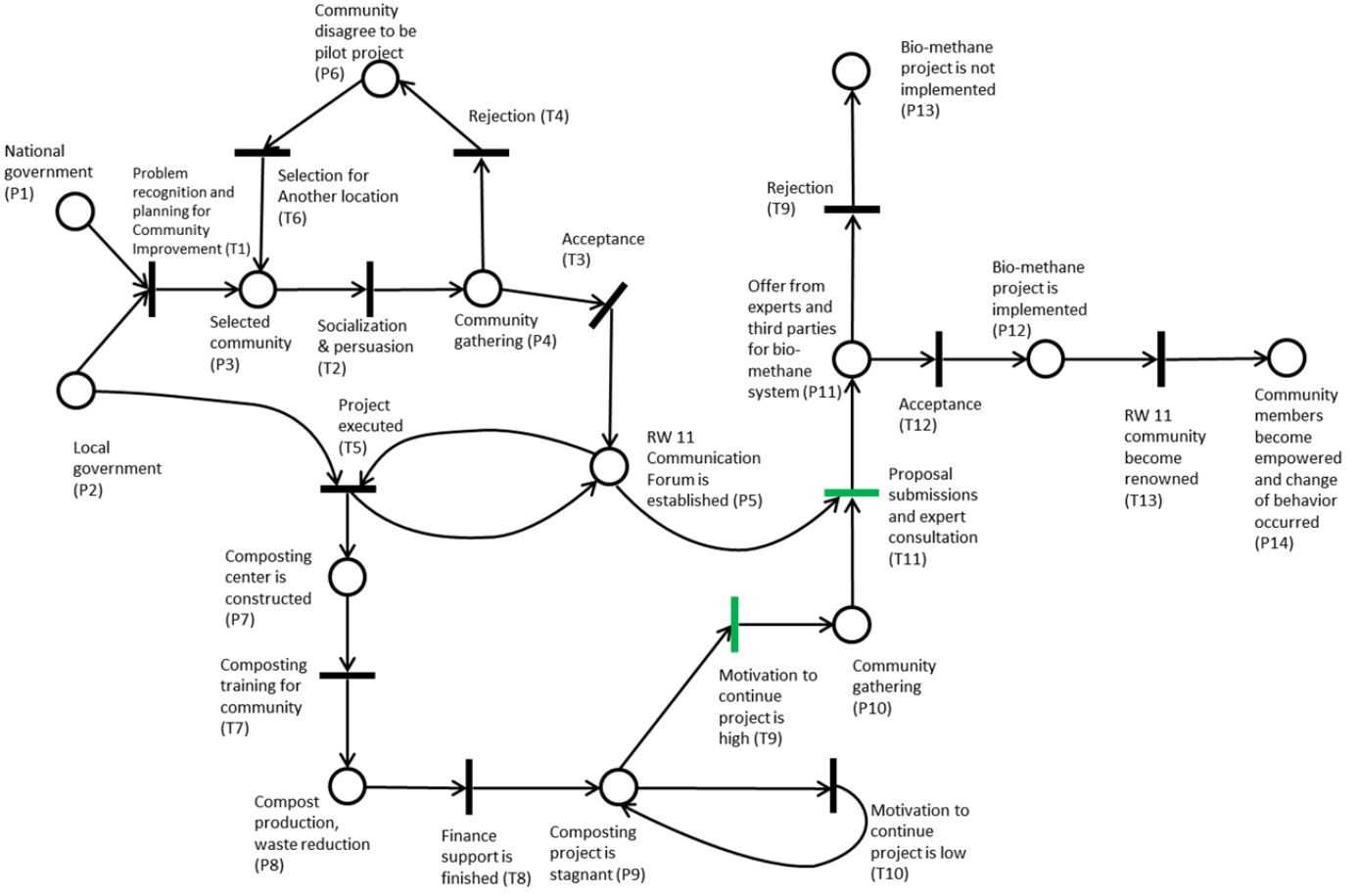
Appendix 1 Decision-making process for Case 1



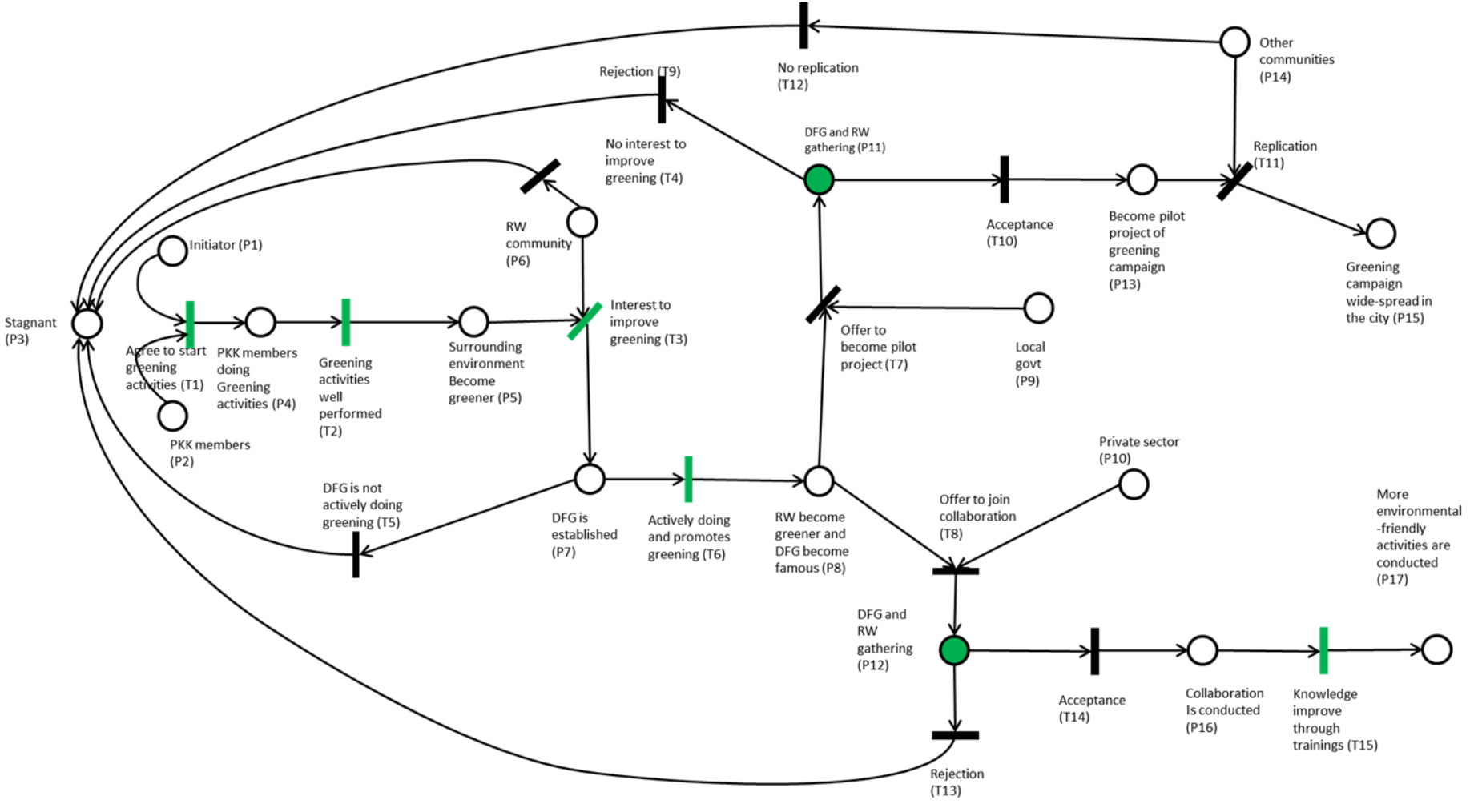
Appendix 2 Decision-making process for Case 2



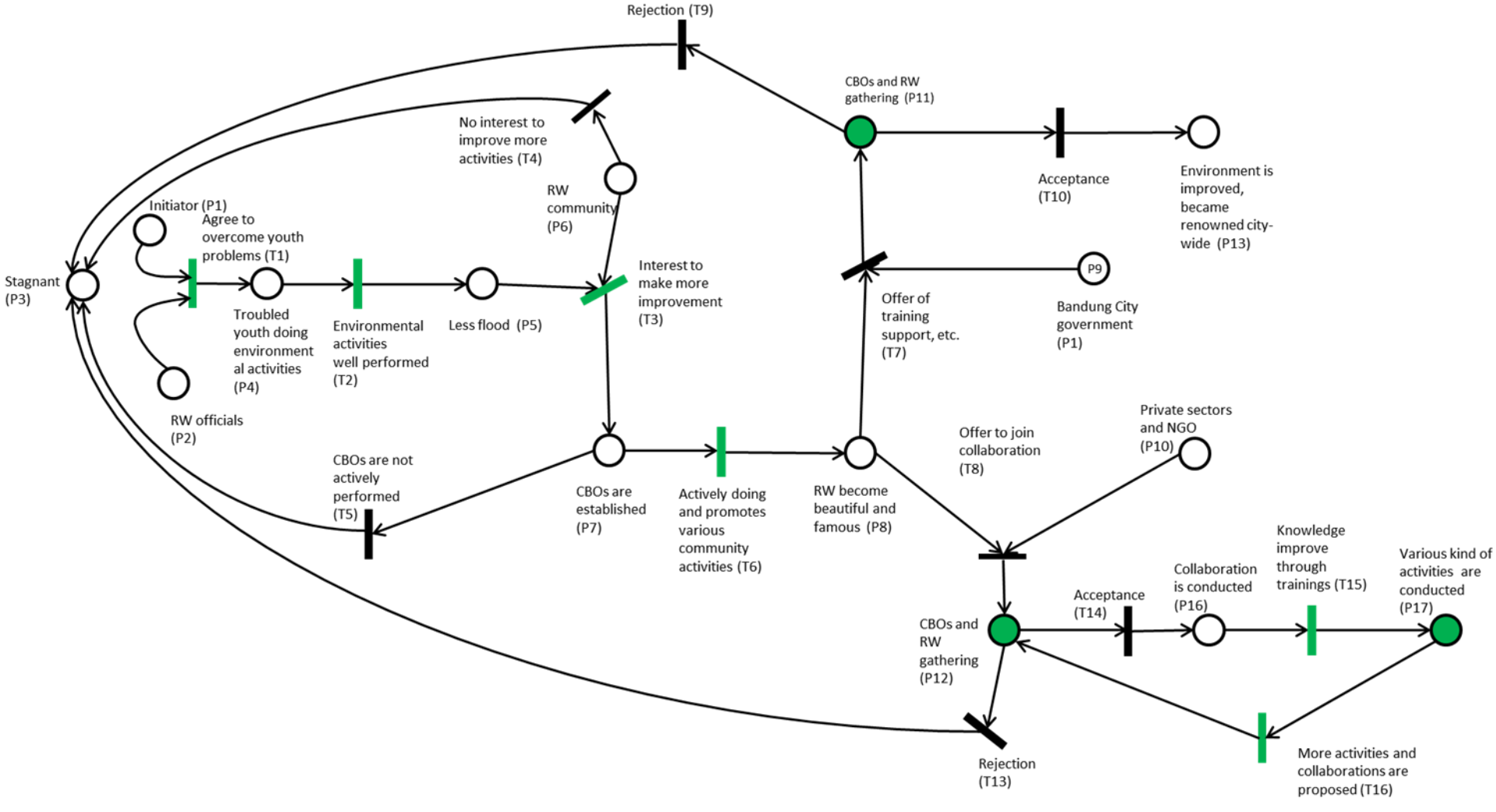
Appendix 3 Decision-making process for Case 3



Appendix 4 Decision-making process for Case 4



Appendix 5 Decision-making process for Case 5


Rejection (T9)
CBOs and RW gathering (P11)
No interest to improve more activities (T4)
RW community (P6)
Acceptance (T10)
Environment is improved, became renowned city-wide (P13)
Initiator (P1)
Agree to overcome youth problems (T1)
Stagnant (P3)
Troubled youth doing environmental activities (P4)
Environmental activities well performed (T2)
Less flood (P5)
Interest to make more improvement (T3)
Offer of training support, etc. (T7)
P9
Bandung City government (P1)
RW officials (P2)
CBOs are not actively performed (T5)
CBOs are established (P7)
Actively doing and promotes various community activities (T6)
RW become beautiful and famous (P8)
Offer to join collaboration (T8)
Private sectors and NGO (P10)
Knowledge improve through trainings (T15)
Various kind of activities are conducted (P17)
Collaboration is conducted (P16)
Acceptance (T14)
CBOs and RW gathering (P12)
Rejection (T13)
More activities and collaborations are proposed (T16)